

Internet Access

Service description Version 3.1

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1. Introduction

This document is subject to change. Telenor reserves the right to change this document to accommodate for development, improvement or adjustments not reducing the quality of add-on services or products. The legally binding version of this document is always the last official version from Telenor.

Internet Access is a service based on Telenor's Nordic Connect product. Nordic Connect is an IP VPN service based on BGP/MPLS as described in IETF RFC 2547.

Internet Access is targeted at large and medium-sized companies in Denmark.

The primary properties of Internet Access are:

- *High Quality connection types*
Only dedicated high quality connection types such as optic fibre connections and radio links are deployed for Internet Access.
- *Differentiated service levels*
Each connection is delivered with a standard service level agreement (SLA) adapted to the market segment. Higher SLA levels are available as an add-on service for locations with special requirements.
- *Constant monitoring*
The availability of the Nordic Connect product is monitored constantly from Telenor's monitoring centre.
- *Availability*
Customer support is provided 24/7/365. Internet Access offers local support at all locations plus one contact point for provisioning and support.
- *Added value*
Customers can reduce their costs and technological risks, while also achieving the highest possible return on their investment. Telenor offers turn-key communication solutions, making it possible for customers to outsource selected tasks and focus on the company's key tasks.
- *Flexibility*
Internet Access offers a high degree of flexibility by allowing the customer's telecommunication solution to grow in step with the company's evolving requirements. The solution is based on principles making allowance for the fact that companies evolve, and requirements thus change – sometimes even at short notice.
- *Performance*
All our communication solutions are thoroughly tested and based on a high level of performance, which will benefit our customers in their day-to-day work.
- *Security and reliability*
With Internet Access, we also offer redundant solutions, making it possible to include the degree of security regarded by the customer as being necessary in the solution. In combination with the possibility to acquire a higher SLA level, this means that the customer is able to influence the security and reliability of the solution.
- *Add-on services*
Internet Access includes a number of add-on services which the customer can choose between, allowing the customer to tailor the solution to ensure that the security level reflects the security required by the company. With a telecommunication solution from Telenor, the customer has the option of implementing a turn-key solution comprising telephony, data and Internet through one access connection.

1.1 Introduction of services

Internet Access is designed for companies requiring...

- a high degree of capacity and flexibility
- reliable solutions
- access technology facilitating a turn-key solution for the customer
- the option of a quick and cost-free upgrade – the customer will only pay for the increased bandwidth
- a fixed monthly price (flat rate)

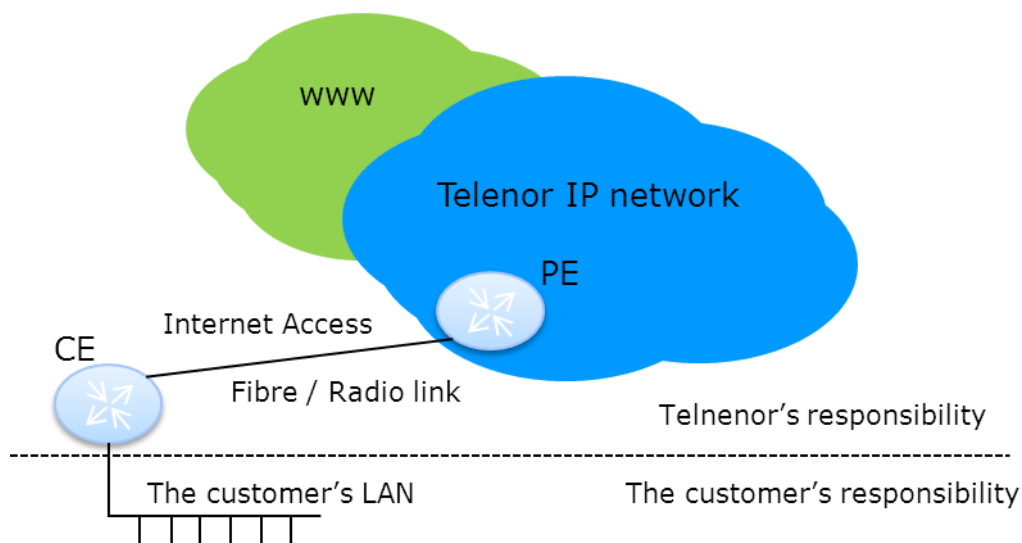
Internet Access is delivered with the following standard features:

- Symmetric bandwidth
- Bandwidths from 10 to 1000 Mbit/s
- Access through fibre or radio link
- Interface/termination in:
 - Fixed Ethernet (FE)/Gigabit Ethernet (GE)
- Free traffic
- SLA level 4.0 (option to acquire higher SLA)
- 8 IP addresses in the subnet
- Reverse DNS integrated

Internet Access is delivered with the following add-on services:

- Extra IP addresses in the subnet – 16, 32, 64, 128, 256 (512 only subject to special agreement). The eight standard IP addresses will be replaced by the extra number of addresses acquired
- SLA 4.3, 5.3, 6.0
- Redundancy (requires acquisition of extra access)
 - Type 2 – two separate access connections to Telenor's network, terminated in the same PE router
 - Type 4 – two separate access connections to Telenor's network; alternatively routed in network and terminated in two different PE routers
- Option to purchase WAN and voice service on the same access line

Internet Access is constantly monitored, 24/7/365, from Telenor's central monitoring centre. Each service is delivered with a standard service level agreement (SLA), which may be upgraded to a higher service level at any time.



1.2 Description of services

The figure below provides a brief overview of the Internet Access service.

Internet Access is a fully operated service. The service comprises a CE router provided and managed by Telenor. The CE router is Telenor's termination point at the customer's location.

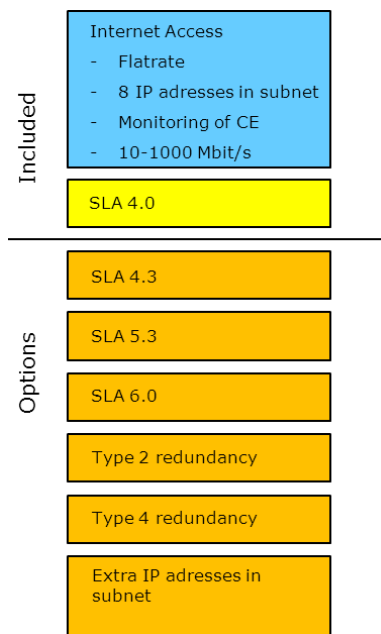


Figure 3 Overview of the Internet Access service

1.3 Coverage area

Internet Access is available in Denmark, with a possible exception being islands not connected by a bridge.

1.4 Last Mile Access

A standard Internet Access solution is established via a radio link or a fibre connection. The customer's solution will be established on one of these two access types, with a given bandwidth chosen by the customer, and may later be upgraded without requiring change of the installation at the customer's location, if possible.

Upgrading the bandwidth within the capacity available on the access line is free.

Downgrading is subject to a charge.

If the customer requires an upgrade or downgrade requiring changing from one access type to another, the costs incidental to this will be charged to the customer in the form of an extraordinary charge, as such technology change is quite costly.

Radio connections require that it is possible to see from the customer's location to the nearest Telenor site. For this reason, an LoS (Line of Sight) reservation is always made.

1.5 Termination at the customer's location/CE router

The customer's connection is terminated in a CISCO router owned by Telenor.

The customer is not permitted to change the router setup, which means that it is Telenor's termination point.

The customer does not have access to Internet routing tables.

1.6 Bandwidth and access technology

It is possible to provide capacity via customer-owned fibre; however, this requires that the customer is on a Telenor POI. The price of this type of solution depends on the setup established.

1.6.1 Bandwidths and access options

The table below shows the Internet Access product bandwidths available as well as the possible access types.

IA Product speed	Internet Access	
	Access type	Shaping speed
10M	Radio/Fibre	10M
20M	Radio/Fibre	20M
40M	Radio/Fibre	40M
100M	Radio/Fibre	100M
200M	Fibre	200M
400M	Fibre	400M
600M	Fibre	600M
1000M	Fibre	1000M

Table 1: Bandwidths and access technologies in Denmark

1.6.2 Redundancy

The bandwidths available for redundant solutions are identical with the above primary connections. A redundant solution requires that both a primary and a secondary access is established.

1.7 Network bandwidth available

The access bandwidths mentioned in the tables above are nominal values. The network bandwidths available for programs are different from these values, which is, among other things, due to:

- *Overhead in IPv4*
Each IPv4 packet has a header of 20 bytes. The percentage overhead is, thus, higher for small packets than for large ones. The overhead for a 128 byte package in IPv4 may, for example, be 16%.
- *Capacity used for operation and monitoring*
For each access line, 8 kbps may be used to monitor the connection and to upgrade and monitor the router included in the service at the customer's location.
- *Bandwidth used for the production of traffic statistics*
Up to 3% of the total access bandwidth may be used to generate and collect statistical material regarding traffic. This information is for internal use only.

The user speed is 80% of the nominal speed measured from the CE router to DIX, 90% of the time, measured over the course of 24 hours. The user speed will never fall below 50%.

1.8 Interfaces and protocols

Access speed	Connection point	Protocol	Comment
10M-100M	RJ-45	100Base-TX	Full duplex
200M-1G	LC SC/PC	1000Base-LX	1300 nm

Table 4: Interface protocols for Internet Access

The network protocol is IP version 4. IPV6 is not supported at this time.

Values may deviate from this table due to differences in CE routers.

1.8.1 Static routing – LAN

The standard routing mechanism between the customer's LAN and Internet Access is static routing.

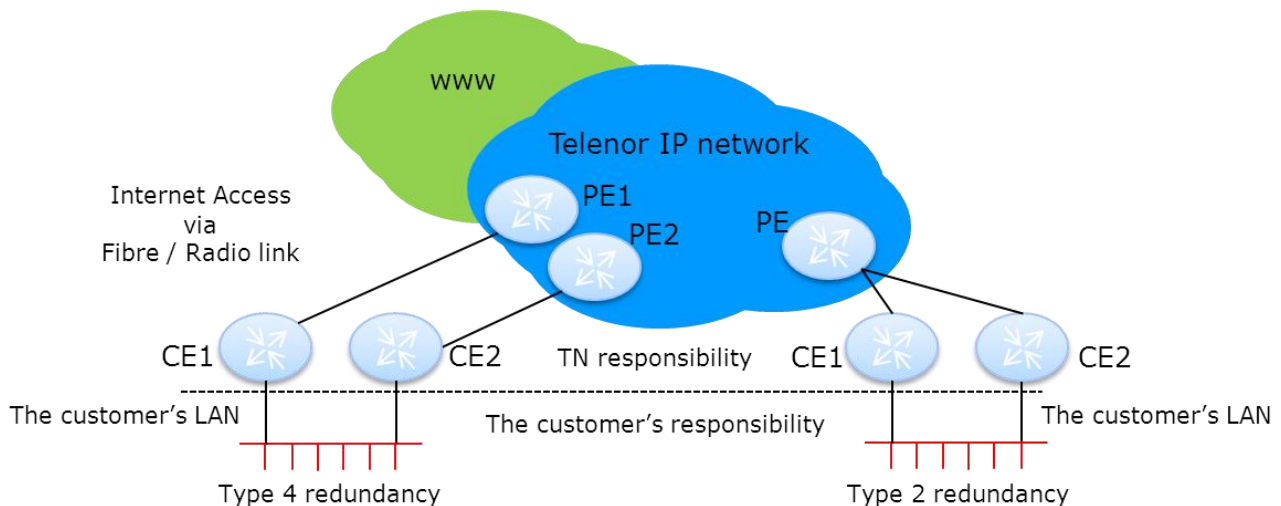
The customer may only use public IP addresses in Internet Access. Telenor selects public connection addresses. The chosen PE-CE connection address block will be visible from the customer's location and will be part of the total solution.

The customer's location is given a LAN subnet (IP addresses), which Telenor registers with RIPE before it may be commissioned. By default, 8 IP addresses are registered in Telenor's IP range for a solution. It is possible to buy more IP addresses, e.g. 16, whereby the 8 standard addresses will be replaced by 16 (this means that the customer will not have 8 + 16, but 16 **instead of** 8 in the example above).

1.9 Add-on products

Add-on products may be purchased as a supplement to the standard service functionality. For add-on products, a registration fee and a current monthly subscription fee will be charged.

1.9.1 Redundant access lines



Type 2 redundancy

- The customer has two access connections to Telenor, routed via two physically separate access types.
- The primary and secondary access connections are terminated in two separate CE routers at the customer's location. The two routers support HRSP (Hot Stand by Routing Protocol) and BGP. The routers are the property of Telenor and are maintained by Telenor.
- The primary and secondary access connections are terminated in the same PE router in Telenor's network.
- The primary and secondary access connections may have the same bandwidth, but this is not a requirement. If a lower bandwidth is chosen for the secondary connection, reduced accessibility may be expected on this connection relative to the primary connection.
- Both access connections use symmetric bandwidth.
- There is no load sharing between the primary and secondary connections, which means that the redundant connection in normal operation will always be without traffic.
- On the customer LAN side, only static routing will be provided, and the CE router only offers default routing.

- Telenor supplies an interface terminated in two separate CE routers. In order for the customer to use the redundant solution as intended, it must be possible to connect Telenor's routers to the customer's own LAN (i.e. the customer must have a suitable LAN), which provides the connection between the two CE routers. This means that the degree of redundancy depends on whether the customer's LAN is redundant in terms of both equipment and power supply (UPS).
- It must be possible to connect Telenor's equipment to a redundant power supply (UPS) at the customer's location in order to achieve 100% redundancy. The customer is responsible for making this redundant power supply available.
- The redundant setup only concerns the part of the solution located in Telenor's own network and does, thus, not apply to breakdown or reduced access to the public Internet.

Type 4 redundancy

- The customer has two access connections to Telenor, routed via two physically separate access types.
- The primary and secondary access connections are terminated in two separate CE routers at the customer's location. The two routers support HRSP (Hot Stand by Routing Protocol) and BGP. The routers are the property of Telenor and are maintained by Telenor.
- The primary and secondary access connections are terminated in their own PE routers in Telenor's network.
- The primary and secondary access connections may have the same bandwidth, but this is not a requirement. If a lower bandwidth is chosen for the secondary connection, reduced accessibility may be expected on this connection relative to the primary connection. If SLA level 5.3 or 6.0 has been chosen, the same bandwidth is required for the primary and the secondary connection.
- There is no load sharing between the primary and secondary connections, which means that the redundant connection in normal operation will always be without traffic.
- On the customer LAN side, only static routing will be provided, and the CE router only offers default routing.
- Telenor supplies an interface terminated in two separate CE routers. In order for the customer to use the redundant solution as intended, it must be possible to connect Telenor's routers to the customer's own LAN (i.e. the customer must have a suitable LAN), which provides the connection between the two CE routers. This means that the degree of redundancy depends on whether the customer's LAN is redundant in terms of both equipment and power supply (UPS).
- It must be possible to connect Telenor's equipment to a redundant power supply (UPS) at the customer's location in order to achieve 100% redundancy. The customer is responsible for making this redundant power supply available.
- The redundant setup only concerns the part of the solution located in Telenor's own network and does, thus, not apply to breakdown or reduced access to the public Internet.
- On the customer LAN side, only static routing will be provided, and the CE router only offers default routing.

General terms for types 2 and 4 redundancy

- The following VLAN may not be used as VLAN ID in the customer's network:
 - VLAN0 (not valid value)
 - VLAN1 (reserved)
 - VLAN16 (Telenor management)
 - VLAN17 (BGP session in redundant solutions)
- In addition, other VLAN may be blocked from the customer's use (depending on geography).
- As a starting point, Telenor will attempt to establish type 2 redundancy, but technical impediments may cause it to only being able to offer type 4 redundancy. There is no

difference in price between the two types. It is exclusively up to Telenor to decide whether type 2 or 4 redundancy can be delivered. The customer should note that SLA 5.3 requires either type 2 or type 4 redundancy, while SLA 6.0 requires type 4 redundancy.

1.9.2 DNS

Primary DNS: 212.88.64.14 (a.res.Telenor.dk)

Secondary DNS: 212.88.64.15 (b.res.Telenor.dk)

Tertiary DNS: 212.88.64.199 (c.res.Telenor.dk)

1.9.3 IP addresses

Telenor handles the administrative process associated with the search for and setup of IP addresses; however, the customer is responsible for supplying sufficient information for use for RIPE applications etc.

Telenor can manage the following number of IP addresses in the subnet.

8, 16, 32, 64, 128, 256, (512)*

* Only in special solutions

As a starting point, eight IP addresses in the subnet are included in the standard product, but it is possible to purchase more.

2. Service level agreement (SLA)

The Service Level Agreement Telenor Internet Access is the main document for all SLA-related issues. If this document deviates in any way from the SLA, the SLA is considered the legally binding document.

2.1 Operational service level agreement

Service level	Service time	Physical fix time	Remote fix time (1)	Automatic failover	Availability per month	Technical requirements
LEVEL 4	Working days Mon-Fri 8 AM – 5 PM		< 4 h		99.60%	None
LEVEL 4.3	All days, 24 hours	< 8 h	< 4 h		99.60%	None
LEVEL 5.3	All days, 24 hours	< 8 h (2)	< 4 h	< 3 min	99.80%	Partly or fully redundant connection (type 2 or 4)
LEVEL 6 (3)	All days, 24 hours	< 8 h (2)	< 4 h	< 3 min	99.99%	Fully redundant connection (type 4)

Table 7: SLA packets

(1) Remote terminal-based error recovery, excluding the access line.

(2) Restoration of primary connection with traffic running on the redundant line.

(3) Requires the same bandwidth on the primary and the secondary connection.

2.2 Technical service level agreement (SLA)

Service class	Typical delay*	Maximum delay	Jitter	Packet loss
Standard data	15-60 ms	100 ms	Not defined	< 0.1%

Table 8: Technical SLA parameters

All data require measurement of a packet size of 100 bytes.

If the lines are overloaded, and the packets are queued in the transmission, the stated delays may be considerably increased. This is, however, an abnormal work situation and may indicate that more capacity is required.

*) A typical delay is delay in one direction from CE-POI. The stated values apply to access lines of 2 Mbit/s, a transport distance from 100 km (min.) to 600 km. (max.) and Cisco IMIX traffic load.

**) The maximum delay is delay in one direction from CE-POI. The stated values apply to access lines of 2 Mbit/s, a transport distance of up to 600 km and Cisco IMIX traffic load. The stated values only apply if the access line is not overloaded.

3. Terms of delivery

3.1 Connection to Telenor's network

Telenor is responsible for terminating the access line in the first assembly point at the customer's location: the connection point. The customer must indicate the location of the connection point and is responsible for ensuring that Telenor is given access to the connection point during installation. The CE router, which is supplied by Telenor, must be set up in the place designated by the customer: the delivery point. The customer may choose between different locations for the connection point and the delivery point. However, connecting the connection point and the delivery point requires internal cabling. The internal cabling is not included in the service, and the customer bears the costs of this.

The customer may choose the cable to be used by Telenor when installing the service. If the internal cabling does not meet Telenor's requirements, Telenor will complete the installation of the service. If the customer does not specify internal cabling, or if the internal cabling does not meet Telenor's requirements, Telenor will arrange for suitable internal cabling and connect the service, if possible.

3.2 Installation requirements for CE equipment

Telenor expects the customer to meet the following requirements for pre-installation preparations:

1. Telenor installs the systems at the customer's location. Space must be cleared for Telenor's equipment in a room of at least 1 x 1 x 1 metres. The room must be a normal office environment with regard to temperature, humidity and atmospheric dust/cleanliness. This means that the requirements for the installation room within the temperature range are 10 °C – 35 °C and with a relative humidity (non-condensing) of 20% - 80%.
2. Access to the installation room and equipment should be restricted to authorised staff. If radio access with antenna is used, the customer must accept and authorise installation of equipment before the installation starts.
3. Electricity and separate circuits etc.
The rooms must be fitted with the required and correct electricity supply of 230 V, 50 Hz (with earth connection) close to the equipment. The electricity supply should preferably be on a separate circuit. The mains voltage may vary by +/- 10%. The frequency may vary by +/- 1%. The equipment will not be delivered with UPS. Before the system is installed, unless otherwise agreed, the customer must make the following preparations in the rooms: The customer must provide 230 V power supply with earth connection.
4. Electrical noise and voltage peaks.
Abnormally strong electrical interference is not allowed in the immediate vicinity of the room. Common transients (office environment) may have a duration of up to 0.2 milliseconds. Although variations as mentioned occur within the mentioned limits, it may not result in interruptions. The responsibility for avoiding damage to equipment due to voltage peaks, e.g. from lightning, lies with the customer.

5. Distribution network and cabling.
Unless otherwise expressly agreed, all connections between implemented Telenor equipment and lines to other units may be created without a requirement for fixed cabling.
6. Other suppliers/contractors.
If implementation of the delivery requires help from other suppliers, e.g. the suppliers that have already delivered equipment to the customer, the customer must ensure that they are available to Telenor without delay.
7. Availability at the time of installation.
The contact must be available (on his or her mobile or the like) to Telenor at the agreed time and place of installation. The contact must have access to the rooms in which the equipment is to be installed, and must have keys and/or other equipment required to have access to the location and the place of installation.
8. Delivery knowledge and information.
The contact at the place of installation must be in possession of the information and have the knowledge required by Telenor to perform the job to the satisfaction of both parties.

Otherwise, there are no specific requirements for the rooms other than the Danish Working Environment Service's requirements for office premises.

In accordance with good supplier practice, the supplier must check well in advance of the installation of the system that rooms and installations meet the requirements in the appendices. The supplier must give the customer written notice of the result of this check in order for the customer to be able to remedy any defects.

3.3 LAN (Local Area Network)

The customer is responsible for the LAN and all equipment used for it.

3.4 Test of service delivery

Installation of the service must always be followed by approval of the service connectivity. If the service is installed by a Telenor technician, this is a process undertaken between the technician and Telenor's operations centre. If the service is installed by the customer, this is a process undertaken between the customer and Telenor's operations centre.

The test must verify the IP connectivity between the telecommunication terminal (CPE) and the core network for the service. If the test result cannot be approved, troubleshooting will be initiated in accordance with the contract.

3.5 Relocation of the service

If the customer moves, the services will be relocated. Relocation of the service is considered a new agreement, and payment will be charged in accordance with the applicable terms. The service can only be relocated to addresses where Telenor is able to deliver the service.

4. Document references

- [1] Service level agreement (SLA) for Internet Access.

5. Terms and abbreviations

ATM	Asynchronous Transfer Mode
BGP	Border Gateway Protocol
CE	Customer Edge
CPE	Customer Premises Equipment
IP	Internet Protocol
ISP	Internet Service Provider
kbps	Kilobit per second
LAN	Local Area Network
LL	Leased Line

Mbps	Megabit per second
PDH	Plesiochronous Digital Hierachy
PE	Provider Edge
SDH	Synchronous Digital Hierarchy
SLA	Service Level Agreement
SNMP	Simple Network Management Protocol
TCP	Transmission Control Protocol
UPS	Uninterruptable Power Supply
VoIP	Voice over IP
VPN	Virtual Private Network
WAN	Wide Area Network
RIPE	Réseaux IP Européens Network Coordination